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Smart in Arranging Food Webs: The Effectiveness of Jarama Card Media in Training Computational Thinking of Fifth Grade Elementary School Students

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ABSTRACT

The development of 21st-century skills requires elementary school students to have computational thinking abilities to think logically, systematically, and structurally. However, these skills have not yet developed optimally, especially on the complex material of food webs. This study aims to describe the effectiveness of the Jarama card media in training computational thinking as well as student response to its use. The study uses a quantitative approach with a pre-experimental type and a one-shot case study design on 26 students of class VB at one of the public elementary schools in Surabaya. Data were collected through post-tests, observations of computational thinking, and student response questionnaires, then analyzed descriptively in a quantitative manner. The results of the study showed that 76.9% of students achieved learning completeness with an average score of 86.6, while observation results showed computational thinking achievement of 80% with a good category. Student response also showed positive categories across all indicators, namely decomposition (2.90), pattern recognition (3.15), abstraction (2.98), and algorithm (2.96). These findings indicate that the Jarama card media is effective for training elementary school student computational thinking on the topic of food webs. Recommendations for further research Developing research with a stronger experimental design, a larger number of subjects.

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INTRODUCTION

The development of 21st-century education requires students not only to master conceptual knowledge but also to possess higher-order thinking skills that support problem-solving abilities. One of the skills that has gained widespread attention in education is computational thinking (Hafild, 2025). Computational thinking is a logical and systematic way of thinking that enables students to break down complex problems into simpler parts through the processes of decomposition, pattern recognition, abstraction, and algorithmic thinking (Irawati & Sofian Hadi, 2025). At the elementary school level, the development of computational thinking is highly important because it can build a foundation for thinking that supports learning at higher educational levels, while also helping students address academic and real-life problems in a more structured manner. Computational thinking skills also need to be developed from the elementary school level because they can help students think logically, structurally, and systematically in solving problems (Perdana et al., 2023). In the context of science and social studies learning, this skill is relevant in helping students understand cause-and-effect relationships, systems, and interaction patterns within ecosystems, particularly in food web material, which is abstract and complex in nature (Ogegbo & Ramnarain, 2022).

One of the learning media that can be used to support the development of computational thinking is the Jarama Card media. Jarama Cards are card-based learning media designed to help students understand the concept of food webs through activities of arranging relationships between organisms within an ecosystem (Febrianasari et al., 2025). This media contains images and information about producers, consumers, and decomposers that can be organized and connected by students into a food chain or food web. The use of card media allows students to learn concretely, actively, and collaboratively through activities such as grouping, matching the patterns of living organism relationships, and arranging the flow of ecosystem interactions systematically. Thus, Jarama Card media not only helps in understanding science concepts but can also train students' computational thinking skills in a contextual manner (Audia et al., 2021).

Previous studies have shown that innovative learning media can support the development of computational thinking skills among elementary school students. Research by Chen et al. (2023) demonstrated that unplugged activities such as card and board games have a large effect size in improving student computational thinking skills in K–12 education. Research by Ardiyanti & Jayanta (2024) also reported that media based on augmented reality and coding significantly improved self-directed learning and computational thinking abilities. In addition, research by Handayani & Handayani (2025) showed that the Assemblr Edu augmented reality media had a significant effect on student critical thinking skills in food web material. These findings indicate that the integration of visual and interactive learning media can support the development of higher-order thinking skills in elementary school students. However, most previous studies have primarily focused on the use of digital media, such as augmented reality, coding, and interactive applications, and have mainly assessed improvements in cognitive learning outcomes or critical thinking skills. Studies that specifically examine the effectiveness of non-digital (unplugged) card-based media in training the four components of computational thinking in food web material at the elementary school level remain limited.

Based on this research gap, this study aims to describe the effectiveness of the Jarama Card media in training the computational thinking skills of fifth-grade elementary school students on food web material, as well as to describe student response after participating in learning activities using the media. Specifically, this study addresses two main research questions:

1. How effective is the Jarama Card media in training elementary school student computational thinking skills?

2. How do students respond to science and social studies learning using the Jarama Card media?

This study has significance for the development of 21st-century skills-based science and social studies learning. It provides an empirical contribution to the study of computational thinking implementation through an unplugged learning approach in elementary schools (Astuti, 2024). Furthermore, the findings of this study can serve as an alternative for teachers in selecting innovative, concrete, and easily applicable non-digital learning media to help students understand food web concepts while simultaneously developing logical, systematic, and analytical thinking skills. In addition, the findings of this study may serve as a reference for the development of computational thinking-based learning media in other subject contexts.

METHODS

Research Design

This study employed a quantitative approach with a pre-experimental research design. The research design used was a one-shot case study, which involves a single group of subjects receiving a treatment followed by measurement after the treatment is administered (Tina Lidyasari et al., 2022). This design was selected because the study focused on measuring the effectiveness of the Jarama Card media after its implementation in learning activities without the presence of a comparison group.

The treatment was conducted through learning activities using the Jarama Card media. During the learning activities, the teacher explained the material and provided an example of how to use the cards. Next, the students were divided into groups and given Jarama Cards containing information or pictures related to the learning material. The students observed, identified, classified, and arranged the cards according to the material being studied in groups. The students discussed to complete the tasks using the cards and then presented their results. The teacher acted as a facilitator by providing guidance and reinforcement throughout the learning activities. After the learning activities using the Jarama Cards were completed, the students were given a *posttest* to determine their learning outcomes after receiving the treatment.

Table 1 below presents the research design.

Table 1. One Shot Case Study Research Design

Treatment	*Posttest*
X	$\boldsymbol{O_1}$

Description:
X: *Treatment* (Using the Jarama Card Media)
O_1: *Posttest*

Research Subject

The research subjects were 28 students from class VB. However, during the implementation of the study, the subjects included in the data analysis consisted of 26 regular students, while two inclusive students were excluded from the data analysis. This decision was made after the research was conducted because, based on observations during the learning process, the two inclusive students required additional assistance and adjustments in following instructions, completing tasks using the Jarama Card media, and working on the research instruments. These conditions could affect the comparability of the measurement results with those of the regular students, while the research instruments were designed based on the characteristics and abilities of regular students. Therefore, the data from the two inclusive students were not included in the analysis so that the research results would

be more consistent with the characteristics of the instruments and the objectives of the study. The selection of class VB was conducted using *purposive sampling* based on the recommendation of the classroom teacher, the suitability of the students' characteristics with the research objectives, and the consideration that the students had previously studied the food chain material and were therefore able to participate in learning activities based on *computational thinking*.

Data Collection

The data collection techniques in this study were adjusted to the research focus, namely to obtain data on student computational thinking skills and student response to the use of the Jarama Card media in science and social studies learning on food web material.

1. Computational Thinking Skills

Data on computational thinking skills were collected through tests (posttest) and observation. The test was administered individually by the researcher to 26 students in the classroom after the learning activities to determine student learning outcomes after using the Jarama Card media. The test consisted of essay questions designed to measure four components of computational thinking. In addition, observations were conducted by the class teacher as an observer during the learning process to directly examine student computational thinking skills. The observation was carried out by assigning yes/no scores to student activities related to decomposition, pattern recognition, abstraction, and algorithmic thinking.

2. Student Response

Data on student response were collected through a questionnaire distributed to all students after the learning activities were completed. The questionnaire aimed to identify student perceptions of the use of the Jarama Card media. Students completed the questionnaire independently by selecting scores for each statement based on their learning experiences.

Research Instrument

The research instruments used in this study were developed based on two measurement focuses, namely students' computational thinking skills and students' responses to the use of the Jarama Card media. All instruments underwent a content validation process before being used in the study. The validation was conducted through expert judgment involving the research supervisor and an expert lecturer with relevant expertise in the field of the study. The validators assessed the suitability of each instrument item with the indicators being measured, the clarity of the language, the relevance of the material, and the suitability of the instruments for the students' characteristics. The validators' assessments and suggestions were then used to revise the instrument items before the instruments were administered in the research.

1. Computational Thinking Skills

The instruments used were a posttest sheet and an observation sheet. The posttest was administered to 26 students at the end of the learning activities to measure their computational thinking skills after the treatment. The instrument consisted of 10 essay questions covering decomposition, pattern recognition, abstraction, and algorithmic thinking. In addition, the observation sheet was used by the observer during the learning process to assess student computational thinking activities. The assessment was conducted by assigning yes/no scores to the observed indicators.

2. Student Response

The instrument used was a student response questionnaire administered to all students after the learning activities to determine their perceptions of the Jarama Card media. The questionnaire used a rating scale consisting of several statements completed based on student learning experiences.

Data Analysis

The research data were analyzed using quantitative descriptive analysis techniques. The *posttest* data were analyzed by calculating each student's score, the class mean, the number of students who achieved the Minimum Competency Criterion (KKM) of 83, and the percentage of classical mastery. The KKM score of 83 was determined based on the regulations applied by the school where the research was conducted. The media were considered effective if the classical mastery reached a minimum of 75%. The *computational thinking* observation data were analyzed by comparing the total score obtained with the maximum possible score, then converting it into a percentage and interpreting it based on the assessment categories. The student response questionnaire data were analyzed by calculating the average score for each indicator, namely decomposition, pattern recognition, abstraction, and algorithm, and then interpreting the results based on the student response criteria with the following score ranges: 3.25–4.00 (very good), 2.50–3.24 (good), 1.75–2.49 (fair), and 1.00–1.74 (bad).

FINDINGS AND DISCUSSION

Findings

The research was conducted in a one-shot case study at one of the public elementary schools in Surabaya, involving 26 students of Class VB as the research subjects in science and social studies learning on food web material using the Jarama Card media. The research results are presented as follows:

1. Posttest Data Analysis Results

The science and social studies learning process on food web material using the Jarama Card media to train computational thinking was successfully implemented. The posttest learning outcomes of Class VB students at one of the public elementary schools in Surabaya are presented in the following table:

Table 2. Posttest Result

No.	Score	Category	Percentage
1.	0–83	Not Yet Achieved	23.1%
2.	84–100	Achieved	76.9%

Based on Table 2, it can be seen that out of 26 students who took the posttest, 20 students (76.9%) achieved mastery, while 6 students (23.1%) did not achieve mastery because they obtained scores below the Minimum Mastery Criterion (MMC). Thus, classically, student learning mastery was achieved, as the percentage of students who achieved mastery exceeded the classical mastery criterion generally set at ≥75%. These results indicate that most students were able to achieve the predetermined learning objectives after participating in the learning activities.

2. Computational Thinking Observation Analysis Results

Data on student computational thinking skills were obtained through observations conducted during the learning process. The observations were not conducted on all students but instead involved

10 students as samples, with the purpose of providing supporting data for the posttest results, which served as the primary data in this study. The results of the computational thinking observations are presented as follows:

Table 3. *Computational Thinking Observation Results*

Respondent	Percentage
Respondent 1	75%
Respondent 2	87.5%
Respondent 3	87.5%
Respondent 4	75%
Respondent 5	75%
Respondent 6	75%
Respondent 7	87.5%
Respondent 8	75%
Respondent 9	87.5%
Respondent 10	75%
Mean	80%

Based on the percentage results of student computational thinking observations in science and social studies learning on food web material using the Jarama Card media, 80% of the planned indicators were successfully implemented, covering all indicators that had been previously developed. Therefore, it can be concluded that student computational thinking skills reached 80%, which is categorized as good.

In this study, the observation results were used to support the main research data, namely the posttest, so to determine the completeness criteria, a combination of both results was required. From the posttest results, the students' classical learning completeness was obtained at 76.9%, which was categorized as high. Meanwhile, from the observation results, it reached 80%, which was also categorized as high. Therefore, based on the criteria that have been determined, the results from the posttest and observation are declared valid learning outcomes, and computational thinking has been trained.

3. Student Response Questionnaire Analysis Results

Based on the data obtained through the student response questionnaire administered after the implementation of science and social studies learning using the Jarama Card media in Grade V, the results are presented in the following table:

Table 4. Student Response Questionnaire Results

No.	Computational Thinking Indicator	Mean Score	Category
1.	Decomposition	2.90	Good
2.	Pattern Recognition	3.15	Good
3.	Abstraction	2.98	Good

No.	Computational Thinking Indicator	Mean Score	Category
4.	Algorithmic Thinking	2.96	Good

Based on Table 4, it can be seen that all computational thinking indicators were categorized as good. The pattern recognition indicator obtained the highest mean score of 3.15, while the decomposition indicator obtained the lowest mean score of 2.90. Meanwhile, the abstraction and algorithmic thinking indicators obtained mean scores of 2.98 and 2.96, respectively. Overall, these results indicate that student response toward learning using the Jarama Card media in training computational thinking skills were positive.

Discussion

Elementary school student computational thinking skills in food web material showed good achievement after participating in learning activities using the Jarama Card media. This was demonstrated through the posttest results and computational thinking observations conducted during the learning process. Based on the posttest results, 20 out of 26 students achieved learning mastery, with a classical mastery percentage of 76.9% and a class average score of 86.6. These results were supported by the computational thinking observation results, which showed a percentage of 80% in the good category. These findings indicate that students were not only able to solve written problems but were also able to directly apply the components of decomposition, pattern recognition, abstraction, and algorithmic thinking through activities such as identifying organisms, recognizing feeding relationship patterns, and constructing food webs using the Jarama Card media. This success indicates that the concrete and manipulative characteristics of the media were able to help students build conceptual understanding while simultaneously training logical and systematic thinking processes. This finding is consistent with Maulah et al. (2025), who reported that interactive and visual learning media can support students' computational thinking through activities involving decomposition, pattern recognition, abstraction, and algorithmic thinking. These findings are consistent with the study by Chen et al. (2023), which demonstrated that unplugged learning activities can improve computational thinking skills through active and contextual learning experiences, as well as the study by Waterman et al. (2020), which stated that the integration of computational thinking in science learning can enhance student conceptual understanding and problem-solving skills.

Student response to the use of the Jarama Card media also showed positive results, with all indicators categorized as good. The pattern recognition indicator obtained the highest score of 3.15, followed by abstraction with 2.98, algorithmic thinking with 2.96, and decomposition with 2.90. These results indicate that students felt that the Jarama Card media helped them recognize patterns of relationships among organisms, understand the material more concretely, and actively engage in the learning process. These findings are in line with the study by Mulyono et al. (2025), which showed that interactive media in food chain material can improve student conceptual understanding, as well as the study by Anjarwati & Mahendra (2025), which found that card-based media can enhance student engagement and learning motivation through manipulative and visual activities.

This study provides both theoretical and practical implications for the development of computational thinking-based learning in elementary schools. Theoretically, this study reinforces the understanding that computational thinking can be developed not only through digital media but also through an unplugged learning approach using concrete media such as cards. This finding is consistent with the study by (Chen et al., 2023), which showed that *unplugged* activities have a positive effect on the development of *computational thinking* skills among K–12 students, particularly through the use of concrete activities and media such as board games and cards that encourage students to solve problems systematically. In addition, recent experimental research has shown that unplugged learning can even

lead to greater improvements in computational thinking skills compared to computer-based learning among elementary school students (Sun et al., 2024). Practically, the Jarama Card media can serve as an alternative for teachers in integrating 21st-century skills into science and social studies learning through contextual, manipulative activities that are aligned with the cognitive developmental characteristics of elementary school students. In addition to helping students understand food web material more concretely, the use of this media also has the potential to increase student active engagement during the learning process. This is supported by studies in elementary education showing that unplugged activities can enhance student learning motivation, participation, and computational thinking skills del Olmo-Muñoz et al. (2020).

This study has several limitations that should be considered when interpreting the research findings. First, the study was conducted in only one class at one elementary school with a limited number of subjects, so the results cannot yet be generalized broadly to different elementary school contexts. Second, the study employed a one-shot case study design without a comparison group, so the effect of the Jarama Card media could not be directly compared with other learning media or instructional strategies. Another limitation is that the measurement of computational thinking skills was conducted within a relatively short period and focused only on one learning topic, namely food webs, so it does not fully represent student long-term skill development.

Based on the research findings and the identified limitations, future studies are recommended to employ an experimental design involving a control group so that the effectiveness of the Jarama Card media can be tested more rigorously. In addition, future research may involve a larger number of subjects, different grade levels, and other science and social studies topics in order to obtain a broader understanding of the implementation of computational thinking-based media. The development of the Jarama Card media may also be integrated with digital technology or other collaborative learning activities in order to provide a wider variety of learning experiences for students.

CONCLUSION

Based on the results of the research and data analysis regarding the use of Jarama Card media to develop students' *computational thinking* skills in elementary schools on the topic of food chains, it can be concluded that the Jarama Card media is effective for use in learning. Its effectiveness is demonstrated by the *posttest* results, with a class average score of 86.6 and a classical mastery percentage of 76.9%, which meets the minimum classical mastery criterion of 75%. In addition, the results of the *computational thinking* observation obtained a percentage of 80%, categorized as good. These results indicate that the use of Jarama Cards can help students develop *computational thinking* skills, including decomposition, pattern recognition, abstraction, and algorithms, through activities involving observing, classifying, connecting, and systematically arranging information.

Students' responses to IPAS learning using the Jarama Card media were also positive, with all response indicators categorized as good. This indicates that the Jarama Card media was well received and could be used effectively by students during the learning process. The use of Jarama Cards provided a concrete learning experience and actively engaged students through group discussions, card arrangement activities, and problem-solving. Therefore, the Jarama Card media not only helped students understand the food chain material but also supported the development of logical, systematic, and structured thinking skills through concrete and contextual learning activities.

Based on the research findings, elementary school teachers are encouraged to utilize concrete learning media such as Jarama Cards as an alternative for integrating *computational thinking* skills into IPAS learning. Future researchers are encouraged to develop similar studies using stronger experimental designs and involving larger numbers of participants so that the effectiveness of the

media can be examined more thoroughly. In addition, the Jarama Card media can be implemented with different topics, grade levels, and learning contexts to obtain more comprehensive findings regarding the use of concrete media in developing students' *computational thinking* skills in elementary schools.

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